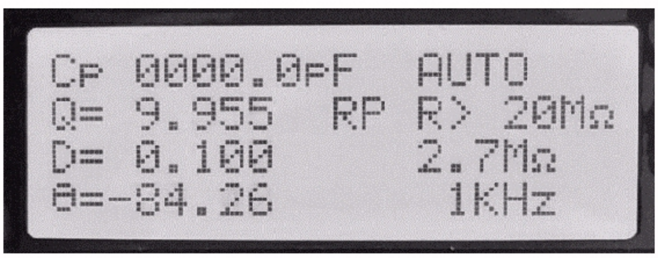
XJW01 LCR Bridge Manual





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Specifications

Features	Measurement method	Freq	Range	Minimum resolution
Capacitor C	Cs/Cp	100Hz	2000.0pF ~ 200.00mF	0.1pF
		1KHz	2000.0pF ~ 20.000mF	0.1pF
		7.8KHz	200.00pF ~ 2.0000mF	0.01pF
Inductance L	Ls/Lp	100Hz	2000.0mH ~ 2000.0H	0.1μH
		1KHz	2000.0mH ~ 200.00H	0.1μH
		7.8KHz	200.00mH ~ 20.000H	0.01μH
Resistance R	Rs/Rp	100Hz	2000.0mΩ ~ 20.000MΩ	0.1mΩ
		1KHz	2000.0mΩ ~ 20.000MΩ	0.1mΩ
		7.8KHz	2000.0mΩ ~ 2.0000MΩ	0.1mΩ

This LCR Digital Bridge may have one of two types of LCD screen.
LCD 1602 can simultaneously display 16x02 characters (32 characters).
LCD 2004 screen can display 20x04 (80 characters).

This guide assumes you have v3.1 hardware and v5.5 firmware.

Note: In this document '**DUT**' means '**Device Under Test**' which could be a resistor, an inductor or a capacitor.

WARNING: Do NOT press the C\ZERO key multiple times in succession! It is possible to reset the device to use the default calibration parameters by pressing the C\ZERO key multiple times.

DIY LCR digital bridge

Measuring range:

Inductance 200mH - 2000H	Minimum resolution 0.01mH
Capacitance 200pF - 200mF	Minimum resolution 0.01pF
Resistance 2000mΩ - 20MΩ	Minimum resolution 0.1mΩ

Secondary parameters display range:

Q: 0.000-999.0

D: 0.000-9.999

θ: -179.0- + 179.0

Relative measurement: -99.9% + 99.9%

Features:

- Main display count max 1999.9, secondary display count 999.9
- Measurement frequency: 100HZ / 1KHZ / 7.8KHZ
- Measuring voltage: 0.2Vrms
- Output impedance: 40Ω
- Basic accuracy: 0.3% after calibration (0.5% default calibration)
- LCR automatic recognition / manual measurements
- Open and short calibration compensation

Main display parameters:

Cp:	Parallel mode capacitance
Cs:	Capacitors in series mode
Lp:	Parallel mode inductance
Ls:	Inductor in series mode
Rp:	Parallel mode resistor
Rs:	Resistor in series mode

Secondary parameters:

Q:	Quality factor
D:	Loss factor
θ:	Phase angle
Rp:	Equivalent Parallel resistance
Rs/ESR:	Equivalent Series Resistance
Xp:	Equivalent Parallel reactance
Xs:	Equivalent Series reactance

Note: Measurements will depend on the test frequency and Series/Parallel selection.

The two types of XJW01 LCR Bridge





These two types use different PCBs but use similar circuits and firmware.

Type 1: Aluminium box - requires external power
Type 2: Mains powered meter

The keys on both types have the same functions but the eight keys are labelled differently!

This manual is mainly written for the Type 1 chassis. If you have a Type 2 case, I suggest you re-label your key pad to make it easier to operate (see end of this manual for alternative labels).

Keypad keys

```
MENU      = M   (Menu - hold for 3 sec. + RNG for Cal. mode)
RNG       = RNG (internal measurement RaNGe)
ZERO      = C   (zero probe Compensation)      [0 / x5 Load Defaults]
HAND\Aut  = L   (ManuaL Adj.)                  [Save Defaults]
CLR       = X   (eXchange C\L\R mode)          [up]
S P\Esr   = R   (Resistance type)              [down]
QTY       = Q   (relative Quantity mode)       [left]
FREQ      = F   (internal measurement Freq.)   [right]
```

[] = Calibration mode
Both types of LCR bridge is use LCR 3.0 hardware and version 5.5 firmware.
Note that the firmware messages assume a Type 2 front panel is present which has 'X' and 'R' keys, etc.

IMPORTANT NOTE: ALL KEYS MUST BE PRESSED DOWN FOR APPROX. 1/3 SECOND - IF THEY ARE PRESSED AND RELEASED TOO QUICKLY THEN THE FIRMWARE MAY NOT DETECT A KEY PRESS.

Key functions
MENU - This key does nothing until you hold it down for approx. 3 seconds. Then it enters the 'LCR Set Options' state. Pressing another key will now take you to a different mode. Pressing CLR\X key will return to AUTO mode.
RNG - This key will usually select a different internal measurement range, e.g. 40R → 1K → 10K → 100K → 40R but if an out-of-range condition is sensed, it may automatically switch to a different range unless you use HAND\Manual mode.
ZERO - When in normal mode this will the start probe auto-compensation process. Short the probes and press ZERO then unshort the probes (no component connected) and press ZERO. When in Calibration mode, this key will set the current value to 0 if pressed once, or it will set all calibration values to the firmware defaults if pressed and released 5 times.
Hand/Auto - MANUAL mode - the display will show 'Hand' at the lower-left. The internal measurement range, internal frequency and series/parallel measurement mode can be changed. Press key again to exit manual mode.
CLR - C\L\R\Auto mode change - changes the type of component measurement, e.g. AUTO → AUTO-C → AUTO-L → AUTO-R → AUTO. Note: CLR does not mean 'clear'!
S P\ESR - In normal mode this key changes the Resistance\Inductance reading from Series to Parallel.
QTY - Relative measurement mode - temporarily stores the current value when pressed - then displays the value and relative difference as a percentage value of any similar component that is connected. Press again to exit relative mode.
FREQ - Changes the internal measurement frequency that is currently being used.

Buzzer - The internal buzzer will beep when some keys are pressed (but not others). Whether the buzzer sounds or not is inconsistent and for some very important actions (such as resetting all internal calibration values) it does not sound! I recommend disconnecting the internal buzzer because as well as being annoying and unhelpful, it also causes the readings to be unstable for several seconds.

Hardware

1. 10-12V (3 x 18650) battery enclosure
2. Kelvin clips (x2)
3. Six 0.1% calibration resistors (+ spare SMT protection diodes)
4. XJW01 LCR Bridge
5. 12V PSU + UK adaptor
6. SMT Kelvin tweezers
7. In-line fuse + spare PCB button switch
8. DC power jack (to be soldered to battery pack and inline fuse)
9. Stand for XJW01



A spare push-button switch is supplied in the original kit because the switch could be accidentally melted when soldering it onto the PCB. It may also be useful if a button gets damaged during use.

The in-line fuse can be useful if you use an external voltage source such as a mains-powered rechargeable lithium-ion battery pack.

Power on

When switched on, you should see this message on the LCD:

LCR 3,0
XJW Putian,2012

The default 'AUTO' measurement state is then entered. The unit will attempt to automatically recognise the type of device currently connected and then select the correct internal test frequency and internal op-amp resistor range to display the most appropriate measurements.

'1602' Screen (16 characters x 2 lines)



If you have this type, you will need to press a key to see the secondary readings (e.g. ESR) because only two lines are on the display.

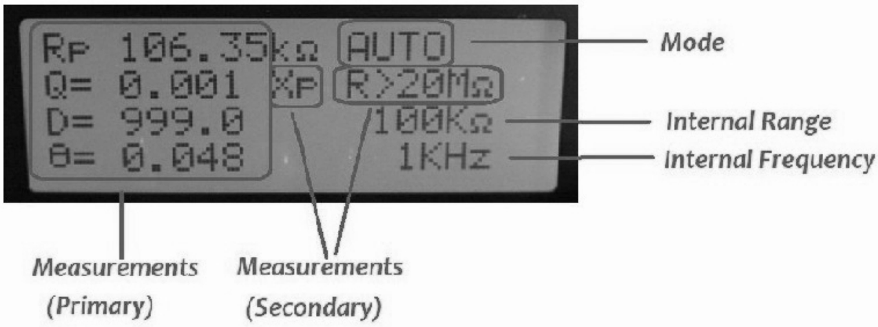
'2004' Screen (20 characters x 4 lines)



Most units have this four line display.

To identify the firmware revision, enter the Calibration mode (see below).

Four-line LCD display fields



Primary Measurements - these will be updated periodically (depending on measurement type, frequency and s=series/p=parallel)
Secondary Measurements - these are also updated automatically (s=series, p=parallel)
Mode - AUTO (automatically determines the 'best' range for the DUT)
Internal Range - this indicates the value of internal resistor that is being used.
Internal Frequency - the LCR bridge can use frequencies of 100Hz, 1kHz or 7.8kHz (check v. component data sheet).

- A negative inductance probably means you are measuring a capacitance. A negative capacitance probably means you are measuring an inductor. A negative DC resistance means something is wrong (try reversing leads/discharging DUT)!
- Use the parallel (p) model when the reactance is greater than 100 Ω. Use the series (s) model when the reactance is less than 100 Ω. Approx. rule of thumb...
  a. At 100Hz, use s for >16µF and p for <16µF (s for <160mH and p for >160mH)
  b. At 1kHz, use s for >1.6µF and p for <1.6µF (s for <16mH and p for >16mH)
  c. At 7.8kHz, use s for >16nF and p for <16nF (s for <160µH and p for >160µH)

Getting started

Your LCR bridge may have been pre-calibrated for you, however it was probably not calibrated with the same probes or power supply that were included with the bridge.

How to press a key

When you press a key, a buzzer may sound to indicate that the key press was detected. However, not all key presses will sound the buzzer even if the key press was detected! Due to software delays, *a quick key press/release can sometimes be missed by the firmware*, so always press a key firmly for at least 1/3 of a second before releasing it.

1. Write down the factory calibration settings

First record the factory values because it is very easy to accidentally destroy the stored values by pressing the wrong keys!

The factory calibration offset values may differ from the firmware default values.

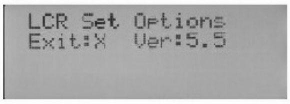
Print out this manual and get a pen and paper and write down all of the 19 calibration values that were set by the factory – follow the instructions below.

IMPORTANT: Do not press the ZERO key during this process!

1. Switch on the LCR Bridge and ensure it shows 'AUTO'.



2. Press the MENU key (the buzzer will sound) and hold it down for 3 seconds until the screen changes to 'LCR Set Options' – the firmware revision will also be displayed.



3. Press the RNG key to enter calibration mode (**IMPORTANT**: do NOT press any keys except for the ones mentioned below). You should now see the Z0 parameter displayed – note down the value (e.g. Z0=79 in the case shown below)…



4. Press the FREQ key (>) to show the next parameter and record that value for Z1...



Tip: You can use the QTY key to go back (<) or the FREQ key to go forwards (>).

5. Repeat... – press the FREQ key and record all 19 values from Z0 up to phX…



6. **Now exit Calibration mode** - When you get back to Z0, press and hold down the MENU key for 3 seconds, then press the CLR key. The display should return to the AUTO measurement mode.

WARNING: If you do not exit the Calibration mode now, you could accidentally delete the calibration values! Make sure the meter displays 'AUTO'. You can turn off the meter at any time if you make a mistake.

2. Probe compensation

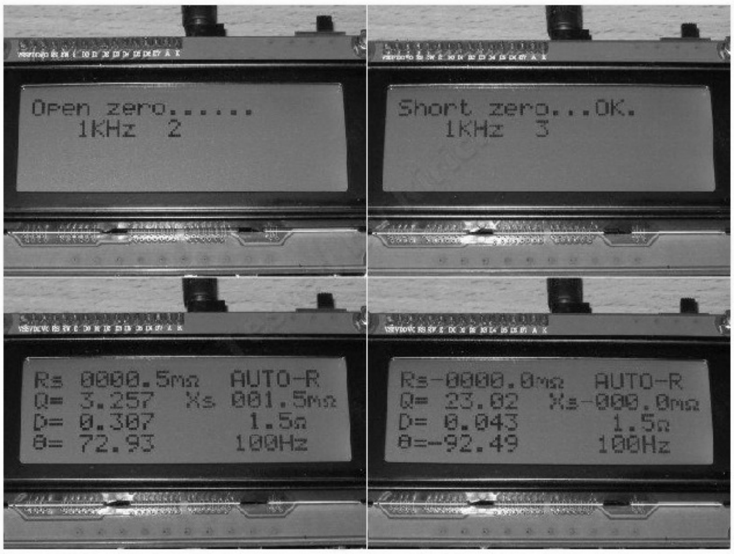
Each time you switch on or connect different test leads, you should first perform a quick lead calibration. Theoretically, you should allow the meter to warm up for 10-15 minutes if you need accurate and stable measurements.

1. **Open zero** - With the test leads **open** (not connected to anything, but close to each other as in normal operation) – press the **ZERO** key – the LCR Bridge will take three measurements at each of the three frequencies. These measurements are used for offsetting the capacitance and inductance measurements.
2. **Short zero** - With the test leads **shorted** together (preferably using a short length of wire with 1cm between the probes to simulate component lead resistance/capacitance) – press the **ZERO** key – the LCR Bridge will take three measurements at each of the three frequencies. These measurements are used for offsetting the resistance measurements.

If you are using the SMT tweezers, take care to close them firmly for the complete duration of the second (short) test (use a 0R SMT resistor if available for highest accuracy).

Tip: If you often swap between the SMT tweezers and the clips, I suggest you label or colour code the BNC plugs and sockets so that you will always connect the same plug to the same sockets each time you swap over the test leads. This will avoid the need to re-zero the test leads each time you re-connect them. I used a permanent ink felt pen to dab on (one, two, three and four) dots onto the cables.

Note: Keep the probes away from electrical appliances and your hands during calibration.



Using the meter

1. Automatic measurement

When the instrument is turned on, the default state of automatic recognition mode is entered (AUTO) and the default measurement frequency is 1KHz.

The impedance characteristics are determined in automatic mode and the most suitable primary parameter is automatically selected (L, C or R) and the most suitable series-parallel mode is automatically selected.

When in the automatic measurement mode, the series-parallel impedance auto-selection is based on the measurement value - when the impedance is high (>10KΩ) it selects parallel, when the impedance is low (<10KΩ) it select series.

WARNING: When connecting components, either in-circuit or out-of-circuit, you must ensure they are completely unpowered and fully discharged. The XJW01 has minimal input protection. In particular, **ensure that capacitors are fully** discharged before connecting the test leads to them.

2. L/C/R mode

AUTO is the default boot state, but you can press the "X-CLR" to select in sequence: "AUTO → AUTO-C → AUTO-L → AUTO-R → AUTO".

For example, if AUTO-R is selected, the meter will always display resistance measurements.

TIP: THINK OF THE 'CLR' KEY AS 'C/L/R'

If the buzzer sounds, you must allow approx. 2 seconds for the reading to settle.

[1602 display only] The secondary parameter can be displayed in measurement mode by using the "R" key to cause the 2nd display line to show either the Q, D, θ, ESR or Xs reading.

3. Series-parallel mode

Normal mode is Series or "ESR" (Rs), press CLR to change to the desired measurement type (e.g. AUTO-R) and S P/Esr to select parallel mode (e.g. "Rp") if required.

Examples:

```
AUTO-R and then press S P/Esr to cycle "AUTO-R →  P C1R → S C1R → AUTO-R"
AUTO-C and then press S P/Esr to cycle "AUTO-C →  P C1C → S C1C → AUTO-C"
AUTO-L and then press S P/Esr to cycle "AUTO-L →  P C1L → S C1L → AUTO-L"
```

Changing s/p mode will also change the reactance reading (Xs\Xp).

4. Changing the measurement frequency

This bridge provides three test frequencies: 100HZ / 1KHZ / 7.8KHZ.

The default frequency on boot is 1KHz.

Press the "(F-FREQ)" key to select a different measurement frequency "1kHz → 7.8kHz → 100Hz → 1kHz ".

When measuring any component, you should refer to the manufacturer's data sheet to determine the correct frequency to use.

In the case where the manufacturers values are measured at a frequency of 10kHz or 100kHz, you must use 7.8kHz and allow for the fact that the LCR bridge results may not be agree with the data sheet.

5. Manual mode (HAND)

This mode allows you manually set the frequency, internal resistor range and series/parallel mode so that it will not be automatically changed by the meter.

Note: Ensure you are in Manual mode [**HAND/s** (series) or **HAND/p** (parallel) mode] before you press the HAND key because if you are in Calibration mode then pressing the HAND key will save all calibration parameters into memory and no visual or audible indication is given!

The L or HAND key should really be labelled as Manual/Auto.

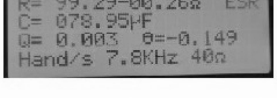
In any measuring mode, press the "HAND" key to enter the manual mode - to exit manual mode, press the "HAND" key again.

CLR - change the mode from series to parallel (the S P\ESR key does nothing in this mode!).
RNG - change the internal measurement range.
FREQ - change internal measurement frequency.
HAND/Aut - exit manual mode.

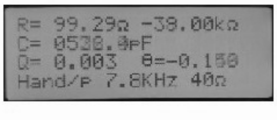
The display will show R, C, Q and phase angle. The top line will show two values for R, the first is the *resistance* reading and the second is the Xs or Xp *reactance* reading (confusingly separated by a - sign). The bottom line shows the series/parallel mode (Hand/s or Hand/p), internal frequency and internal resistance range being used.

- The reactance may be displayed on the top after the - sign (don't mistake this for a +/- difference value).
- The reactance value will depend on the measurement frequency.

100R Resistor



R is the Series resistance, 00.26 is Xs



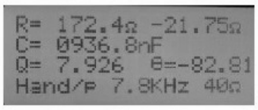
R is the Parallel resistance, 00.39.00k is Xp

1000nF Capacitor

If measuring a capacitor, the *first R value will be the Rs (ESR) value* if 'ESR' in shown on the display and Hand/s is shown at the bottom or else it will be the Rp value if Hand/p is displayed at the bottom of the screen.



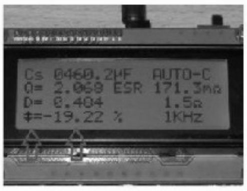
R is the Series resistance, 21.40 is Xs (which can be measured as Xs using the AUTO-R range)



R is the parallel resistance, 21.75 is Xp (which can be measured as Xp using the AUTO-R range)

6. Relative measurements (QTY)

This mode allows you to sort through a batch of components with similar values. You first select the component that you want to use as the standard (exemplar) and then press QTY – you can now connect each new component in turn to display its value and the %age variation from the first components value.



1. Select the desired mode (e.g. AUTO-C) and connect an exemplar component.
2. In any measurement mode, press the (Q-QTY) key to enter the relative measurement mode (an up-arrow\down-arrow symbol should appear at the bottom left of the LCD display).
3. Now connect a similar component to measure. In the relative measurement mode, the relative difference is expressed as a percentage.
4. The CLR or S P\ESR keys will exit the relative measurement mode.

Notes:

- RNG will change the internal measurement range and FREQ will change the internal frequency but these will cause the %age reading to be invalid!
- Percentage limits are: -99.9% + 99.9% (if they are > +/-100% then "OL" (*overload*) will be displayed).

7. Calibration mode (Menu+RNG)

The LCR bridge stores 19 internal offset calibration values. These are loaded on power-up by the firmware from the non-volatile internal memory.

To enter calibration mode: Hold down the " (M-MENU)" key for approx. 3 seconds to enter the 'LCR Set Options' menu system and then press the "Range (RNG)" key.

To exit calibration mode: Press the "menu (M-MENU)" key to enter the main menu, and press (X-CLR) to return to measurement mode.

MENU	**RNG**	**ZERO** (0\reset defaults)	**HAND** (save all)
CLR (up)	**S P/ESR** (down)	**QTY** (back)	**FREQ** (next)

In calibration mode use (Q-QTY/**left**) and (F-FREQ/**right**) to select the calibration items.

You can use (X-CLR/**up**) and (R-SP/ESR/**down**) for adjusting the calibration parameter values.

ZERO key: You can press the (C-ZERO) key *ONCE ONLY* to set a value of 0 for the current value.
WARNING: If you press the ZERO key 5 times, it will reset all values to their default values when in calibration mode - no warning or indication is given (except that the current value may change from 0 to the default value for that parameter)!

Changes to these 19 calibration values will affect all future readings until the unit is powered off and on again so that the saved values are re-loaded by the firmware.

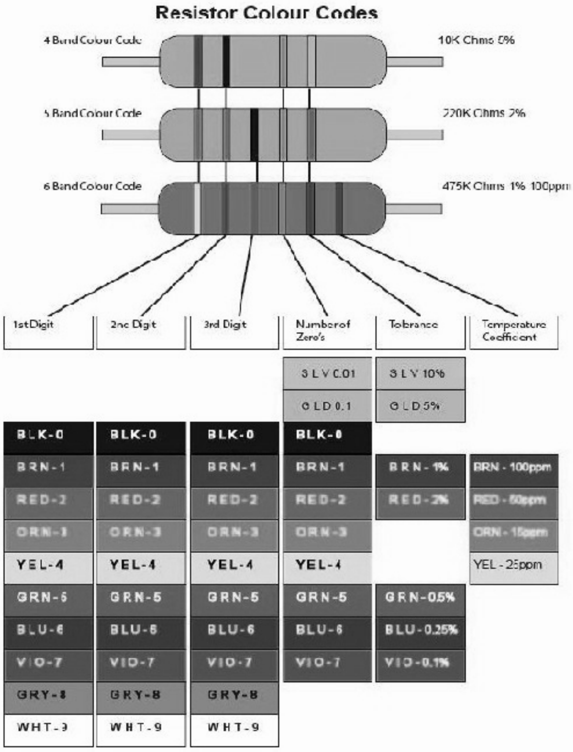
Save all values: Pressing the HAND/Aut key *once* at any time will save all the calibration results into non-volatile memory. This must be done to store the values so they are remembered after power off.

Reset to default values: 5 slow press\releases of the ZERO key at any point whilst in the Calibration mode will load ALL the default calibration values into all the 19 calibration parameters. If the HAND key is then pressed to save all the current values, the 'factory' calibration settings will be lost forever and the default firmware offset values will be loaded after power-up.

A reset to defaults should restore a basic (uncalibrated) accuracy of 0.5% to 1%.

7.1 The calibration process

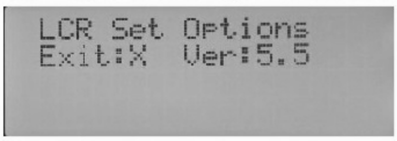
You will need 0.1% calibration resistors, these will have a purple end-band.



40R, 1K, 3K, 9K, 10K and 100K 0.1% resistors (6 in total) are required and are usually supplied with each LCR bridge. An extra 25R resistor is also optionally required but is not supplied in the kit.

7.2 Enter the calibration mode

Hold down MENU for approx. 3 seconds to display the following:



Once in the 'LCR Set Options' mode, you can press:

- **CLR** key to return to *measuring mode*.
- **RNG** key to enter *calibration mode*.
- **FREQ**: (function unknown) displays 'Feq correct 0.000'
- **S P/ESR** Op Amp gain - displays 'up:0 dw:2' [op amp gain position used for the upper and lower arm measurements to calibrate the phase error of the controllable gain op amp. The upper arm gain is shown first followed by the lower arm gain.]
- **HAND** Debug mode - displays 'xw=0 K3=1 Ga=2 23' [details unknown]

To start the calibration:

1. Switch off and switch on.
2. Perform a short and open test lead calibration by using the ZERO key twice.

3. Ensure you are in **'AUTO' mode** (you must NOT change the Frequency or Range before entering calibration mode!).
4. Press and hold down the **MENU** key for 3 seconds until the display changes.
5. Now enter the *Calibration mode* by pressing **RNG** - the "Z0" reading should appear on the display.

[Type 1 - front panel keys when in calibration mode]

MENU	**RNG**	**ZERO** (0\reset defaults)	**HAND** (save all)
CLR (up)	**S P/ESR** (down)	**QTY** (back)	**FREQ** (next)

In Calibration mode:

- Press **FREQ** to access the next parameter.
- Press **QTY** to access the previous parameter.
- Press once or hold down **CLR** or **S P\ESR** to increment or decrement the parameter value.
- Press **ZERO** *once only* to set the current parameter value to 0.
  WARNING: If you press the ZERO key 5 times consecutively, then ALL the default values will be set for ALL the parameters!
- Press **HAND** key once at any time to *save all 19 values* into non-volatile memory (this cannot be undone by switching off and again).

Use FREQ to cycle through each parameter, connect the correct 0.1% resistor and adjust them as detailed below using the up/down keys. You can adjust the following parameter values using the ZERO (0), CLR (up) and S P\ESR (down) keys to obtain the 'Target' value.

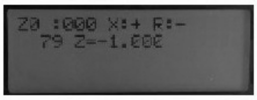
It is important to go through each step in sequential order because the setting of earlier calibration offsets may skew the results of later offset values.

Notes:

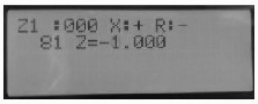
- The display of "**X:+ R:-**" indicates to the user that the X and R keys ("CLR" and "S P\ESR") can be used to increment and decrement the calibration offset value.
- Calibration offset values can range from -128 to +127.
- Some of the example screenshots below did not have the correct calibration resistors connected so ignore the actual reading displayed.

7.3 Setting all 19 calibration values

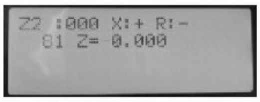
For each parameter, adjust the offset value to obtain the 'Target' reading.
The firmware default offset values are shown in parentheses...



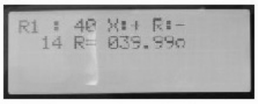
Z0: Short the terminals [100Hz calibration] Target Z=0 (default 76)



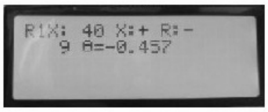
Z1: Short the terminals [1kHz calibration] Target Z=0 (default 78)



Z2: Short the terminals [7.8kHz calibration] Target Z=0 (default 78)



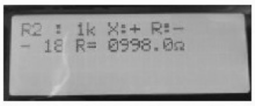
R1: Connect 40R [V/I converter arm resistance] Target R=040.00R (default 20)



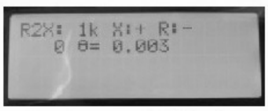
R1X: Connect 40R [40R phase] Target $\theta=0$ (default 0)



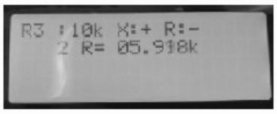
ak: Connect 25R [linear calibration] Target R=25R ?? (default 0) (typ. 0 – set 0 if no 25R available). If you have a high-tolerance resistor near 25R then use that and adjust the offset to match your resistor value.



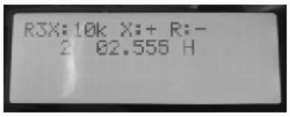
R2: Connect 1k [V/I convert arm resistance] Target R=1000.0R (default 0)



R2X: Connect 1k [1k phase angle] Target $\theta=0.00$ (default 0)



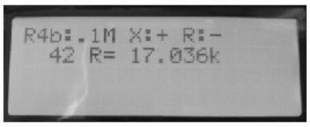
R3: Connect 10k [V/I convert arm resistance] Target R=10.000k (default 2)



R3X: Connect 10k [10k phase] Target=0pF (default 6)



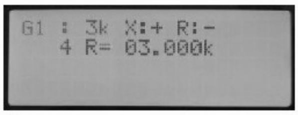
R4: Connect 100k [V/I converter arm resistance] Target R=100.0k (default 24)



R4b: Connect 100k [7.8kHz amplitude calibration] Target R=100k (default 28)



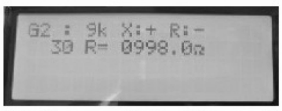
R4X: Connect 100k [100k phase] Target 000.0pF typ. 21 (default 29)



G1: Connect 3k [calibrate gain of op amp 3k] Target R=03.000k (default -2)



G1X: Connect 3k [3k phase shift] Target 000.00pF (default 32)



G2: Connect 9k [calibrate gain of op amp 9k] Target R=09.000k (default -10)



G2b: Connect 9k [7.8kHz amplitude calibration] Target R=09.000k (default 2)



G2X: Connect 9k [phase shift 9k] Target 000.00pF (default 24)



PhX: Connect 1k [phase calibration 1k] Target θ=0.000 (default 0)

7.4 Save the settings

Once you have set the calibration parameters, save them all by pressing L-HAND once whilst still in Calibration mode (no indication is given).

7.5 Reset to firmware defaults

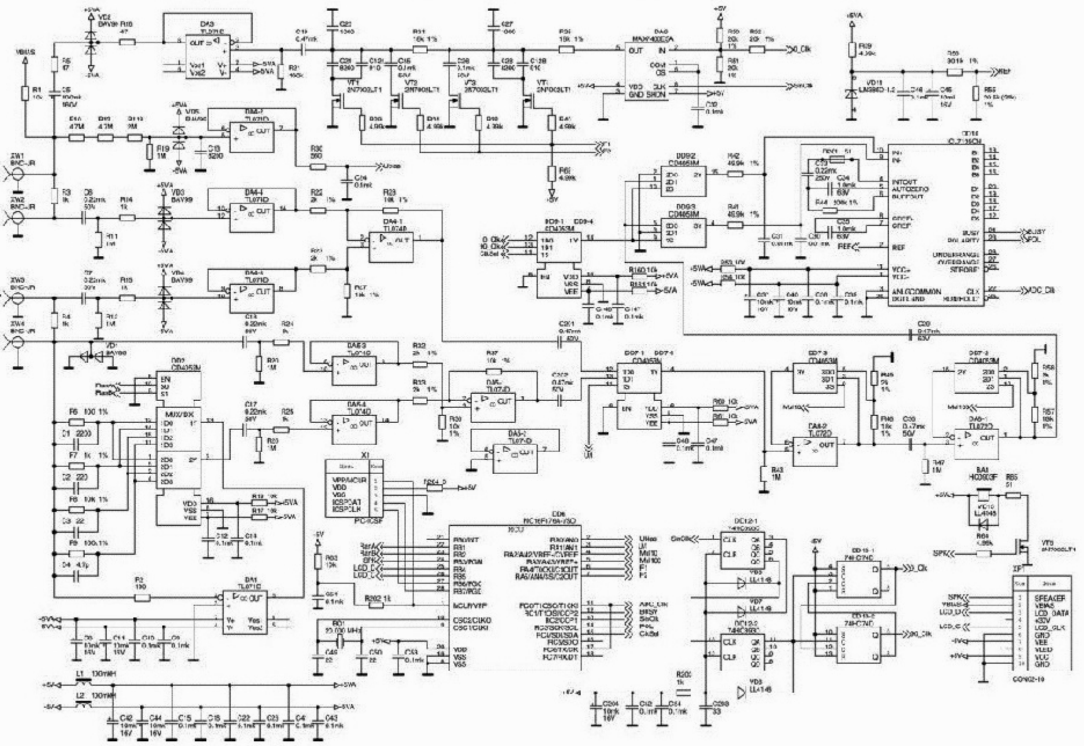
1. Press and hold down the **MENU** key for 3 seconds to get to the 'LCR Set Options' menu.
2. Press the **RNG** key to enter the calibration menu.
3. Check that the Z0 parameter is now displayed
4. Press the **ZERO** key once (the Z0 parameter should be set to 0)
5. Continue to press the **ZERO** key again 4-5 times until Z0 changes to 76 (default for Z0) - note: this loads ALL default values into ALL the calibration offset parameters.
6. Press the **HAND** key for 1/3 second to save all the default values (no indication is given).
7. Exit by holding down the **MENU** key for 3 seconds and then press the **CLR** key to exit the calibration menu.

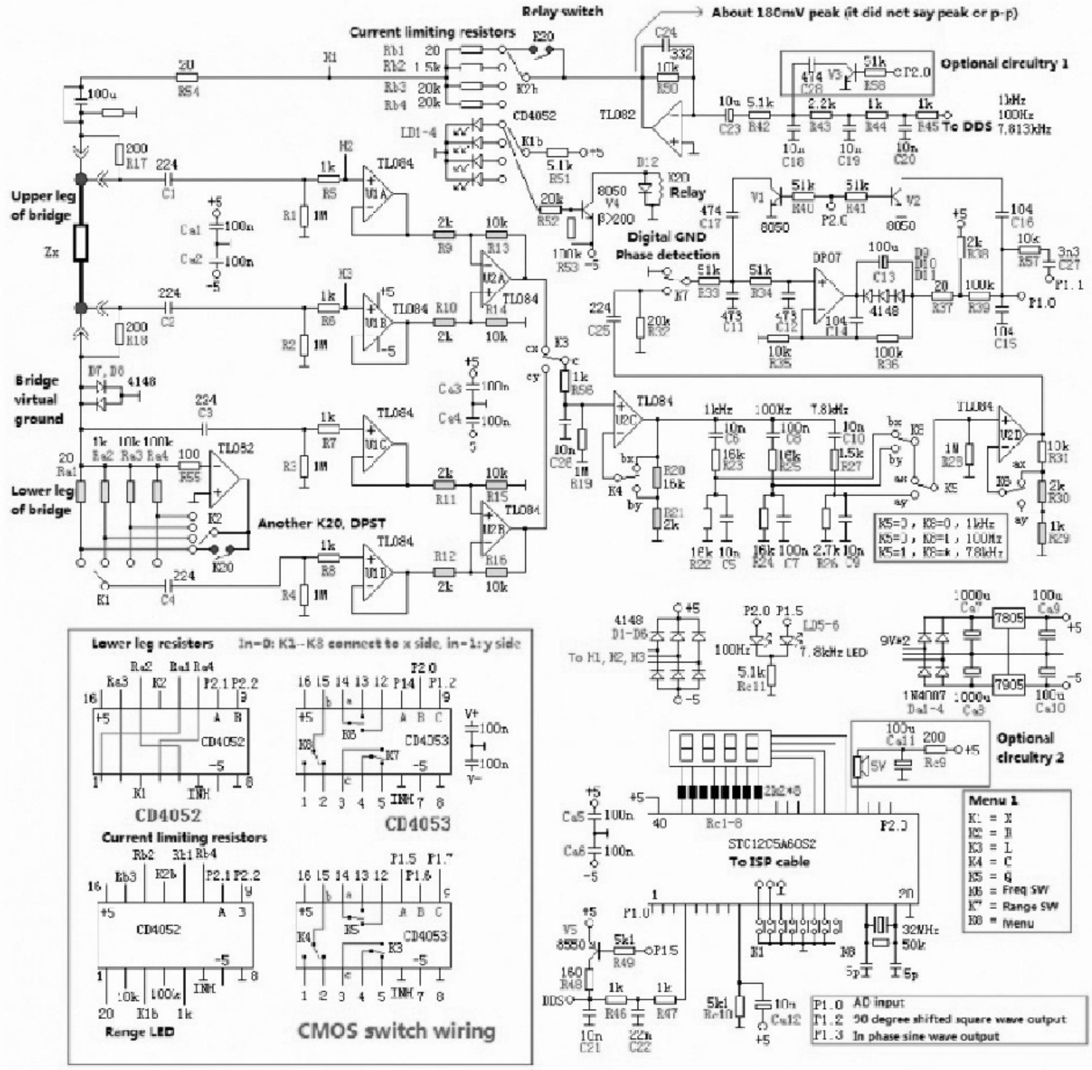
Schematics

PCB REV 1.1

CIRCUIT REV 3.1 2017/03/28

The schematics below may be old and inaccurate (translated from Chinese)!





K1, K2 = CD4052
K3, K4, K5 = CD4053
K6, K7, K8 = CD4053
K1b: renge LED indicator switch
K2b: current limiting resistor switch
K1, K2: range switch
K3: mV meter output switch, for measuring ampliture ratio and phase shift between 2 phase legs.
K4, K6: gain control
K5, K8: 1k, 7.8k, 100Hz BPF switch
K7: phase detector sensitivity switch

Key	Type 1	Type 2	
K1	CLR	X (C\L\R select)	[up]
K2	S P\Esr	R (Resistance type)	[down]
K3	HAND\Aut	L (Manual)	
K4	ZERO	C (Compensate)	
K5	QTY	Q (relative mode)	[left]
K6	FREQ	F	[right]
K7	RNG	RNG	
K8	MENU	M	

Type 1 LCR Bridge PCB

